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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/749,986	12/31/2003	Donald S. Gardner	42P18458	9962

8791 7590 03/23/2006

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EXAMINER
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DUPUIS, DEREK L

ART UNIT	PAPER NUMBER
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2883

DATE MAILED: 03/23/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/749,986

Applicant(s)

GARDNER ET AL.

Examiner

Derek L. Dupuis

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 17 February 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 32-60 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 32-60 is/are rejected.
- 7) ☒ Claim(s) 32, 43, 44 and 55 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 February 2006 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 2/27/06.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 2/17/2006 has been entered.

### ***Response to Arguments***

2. Applicant's arguments with respect to claims 32-60 have been considered but are moot in view of the new ground(s) of rejection.

### ***Terminal Disclaimer***

3. The terminal disclaimer filed on 2/21/2006 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of any patent granted on application number 11/121,580 has been reviewed and is accepted. The terminal disclaimer has been recorded.

### ***Information Disclosure Statement***

4. The information disclosure statement (IDS) submitted on 2/27/2006 has been considered by the examiner.

### ***Drawings***

5. Amendments to the drawings were received on 2/27/2006. These drawings were not entered as indicated in the miscellaneous office action mailed 3/6/2006.

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6. The drawings are objected to because the shading in the figures makes it difficult to distinguish features in the drawings. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

#### ***Claim Objections***

7. Claim 43 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 43 merely restates a limitation already present in the independent claim.

8. Claim 55 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the

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claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 55 merely restates a limitation already present in the independent claim.

9. Claim 32 is objected to because of the following informalities: the phrase “including one or more of nanocrystals in a matrix” should apparently be “including one or more nanocrystals in a matrix” or should apparently be “including nanocrystals in a matrix”. Appropriate correction is required.

10. Claim 32 is objected to because of the following informalities: in the last paragraph, the phrase “a pump disposed vertical relative” should apparently be “a pump disposed vertically relative”. Appropriate correction is required.

11. Claim 44 is objected to because of the following informalities: the phrase “wherein the pump is to tunnel” should apparently be “wherein the pump is used to tunnel” or should apparently be “where in the pump tunnels”. Appropriate correction is required.

***Claim Rejections - 35 USC § 103***

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

13. Claims 32-60 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Armani et al* (US 2004/0179573 A1) in view of *Chan et al* (US 6,236,060 B1) and in view of *LoCascio et al* (US 2003/0016907 A1).

14. Regarding claims 32-35, 40, 43-45, 47, 51, 52, and 55-59, Armani et al teach an apparatus shown in figures 1, 4, 6, and 7. The apparatus includes a silicon substrate (120) (see paragraph 12). A microresonator (110) with an annular structure is disposed on the substrate (120) as shown in figure 1. The microresonator (110) is used to recirculate light at a desired wavelength (see paragraph 4). Armani et al also teach the use of an optical pump to excite circulation of light in the microresonator (see paragraph 50).

15. Armani et al do not explicitly teach that the microresonator comprises silicon dioxide with silicon or silicon germanium nanocrystals. Armani et al also do not teach that a pump tunnels current through the silicon dioxide to form electron-hole pairs in the nanocrystals. Chan et al teaches a light emitting device comprising electrically conductive materials. Chan et al teaches that it is well known to inject silicon nanocrystals or silicon-germanium nanocrystals into a layer of silicon dioxide (see column 3, line 59 to column 4, line 16 of Chan et al). Chan et al teach that it is also well known in the art to tunnel current from a source to create electron-hole pairs in nanocrystals (see column 2, lines 43-55).

16. It would have been obvious to one of ordinary skill in the art at the time of invention to modify the micro-resonator of Armani et al by injecting silicon or silicon-germanium nanocrystals into a layer of silicon-dioxide and tunneling current through the layer to form electron-hole pairs in the nanocrystals as taught by Chan et al. Motivation to do this would be to result in a "high efficiency electroluminescent structure" (see column 2, lines 50-55 of Chan et al). Armani et al also suggest that the silicon dioxide of the microresonator can include an added dopant or embedded active optical component (see paragraph 59). These suggestions would lead one of ordinary skill in the art to combine the teachings of Armani et al and Chan et al since

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Armani et al suggests adding a dopant or active optical element and since Chan et al suggests improved optical effects can be achieved by adding nano-crystals into an optical medium.

Furthermore, additional motivation would be that it is common practice in the art to channel current through an oxide layer to form electron-hole pairs to excite energy.

17. Neither Armani et al nor Chan et al teach that the silicon nanocrystals are formed in an  $\text{AlSiO}_x$  matrix. LoCascio et al teach a microresonator as shown in figure 12 that includes an annular structure including nanocrystals formed in a matrix. LoCascio et al teach that the matrix can be made of silicon (see paragraphs 52 and 55). LoCascio et al also teach that the microresonator can be pumped for an optical light source located above the microresonator (see paragraph 81). The microresonator is also coupled to two patterned waveguides (106 and 107) that are formed on a substrate. The waveguides are vertically coupled to the microresonator at a location below the microresonator as can be seen in figure 12. LoCascio et al do not explicitly teach that the matrix is  $\text{AlSiO}_x$  or that the waveguides are located above the microresonator. However, these would be obvious modifications. It would have been obvious to one of ordinary skill in the art at the time of invention to use  $\text{AlSiO}_x$  in place of silicon in the matrix since  $\text{AlSiO}_x$  and silicon are both known to be equivalent for their use in the optical semiconductor art and the selection of any of these known equivalents would be within the level of ordinary skill in the art. It would have been obvious to one of ordinary skill in the art at the time of invention to place the waveguides above the microresonator (instead of below) since it has been held that rearranging parts of an invention involves only routine skill in the art. In re Japikse, 86 USPQ 70.
18. It would have been obvious to one of ordinary skill in the art at the time of invention to modify the microresonator taught by Armani et al in view of Chan et al by placing the

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nanocrystals in a matrix, coupling the microresonator to patterned waveguides, and pumping the microresonator with a light source as taught by LoCascio et al. Motivation to do this would be the suggestion by Armani et al to couple waveguides to the microresonator (see figures 4A, 4B, and 7A). While the waveguide shown in the figure is a fiber, Armani suggests that the waveguide could have other configurations (see paragraph 47). Further motivation that would lead one of ordinary skill in the art to combine the LoCascio reference with the teachings of Armani and Chen would be that the nanocrystal arrangement used by LoCascio allows for controlling and “altering the resonant condition of the microcavity” through the illumination provided by the pump source (see paragraph 26). This allows for the resonator to resonate wavelengths of any size (see paragraph 52).

19. Regarding claims 36-39, 48, and 49, Armani et al in view of Chen et al and in view of LoCascio et al teach an apparatus as discussed above in reference to claims 32 and 45, respectively. Armani et al teach that the annular structure can be a ring or a disk (see paragraph 26). Armani et al teach that the optical energy within the microresonator can be resonant in a whispering gallery mode (WGM) (see paragraph 12). By definition, a microresonator where the energy is resonant in a WGM inherently has a circumference that is an integer multiple of the wavelength of the optical signal. The length from the center of the disk to the center of the waveguide forming the disk is, by definition, the radius of the disk. Therefore, radius of the disk is proportional (by  $2\pi$ ) to the circumference which is an integer multiple of the wavelength of the optical signals being resonated in the microresonator. By definition, a disc structured microresonator where the energy is resonant in a WGM inherently has a perimeter that is an integer multiple of the wavelength of the optical signal.



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20. Regarding claims 41, 42, and 50, Armani et al in view of Chen et al and in view of LoCascio et al teach an apparatus as discussed above in reference to claims 32 and 45, respectively. Armani et al teach that the microresonator comprises a rare earth, specifically, erbium or ytterbium (see paragraph 14).

21. Regarding claim 46, Armani et al in view of Chen et al and in view of LoCascio et al teach an apparatus as discussed above in reference to claim 45. Armani et al teach that the distance between a waveguide and the microresonator is "in the order of hundreds of nanometers". This range includes the claimed range of being less than or equal to 250 nm. In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). See MPEP 2144.05.

22. Regarding claims 53 and 60, Armani et al in view of Chen et al and in view of LoCascio et al teach an apparatus as discussed above in reference to claims 45 and 57 respectively. Armani et al teach that an optical pump source (420) can be used to pump the waveguide. LoCascio et al teach using a light source to pump the microresonator (see paragraph 81). However, neither Armani et al, nor Chen et al, nor LoCascio et al explicitly teach that the pump light source is an LED. However, it would have been obvious to one of ordinary skill in the art at the time of invention to use an LED as a light source to pump light since LED's are routinely used in the art of optics as pump sources.

23. Regarding claims 54, Armani et al in view of Chen et al and in view of LoCascio et al teach an apparatus as discussed above in reference to claim 53. Armani et al, nor Chen et al, nor LoCascio et al explicitly teach that the LED emits light at a wavelength of less than 900nm.

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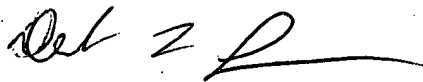
However, it would have been obvious to one of ordinary skill in the art at the time of invention to use an LED that emits light at a wavelength of less than 900nm since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Derek L. Dupuis whose telephone number is (571) 272-3101. The examiner can normally be reached on Monday - Friday 8:30am-4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank G. Font can be reached on (571) 272-2415. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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